

**Civilian Radioactive Waste
Management System**

**Management & Operating
Contractor**



**TRW Environmental Safety
Systems Inc.**

Degradation Sequence of Internal Basket Structure and Commercial SNF After Waste Package Breach

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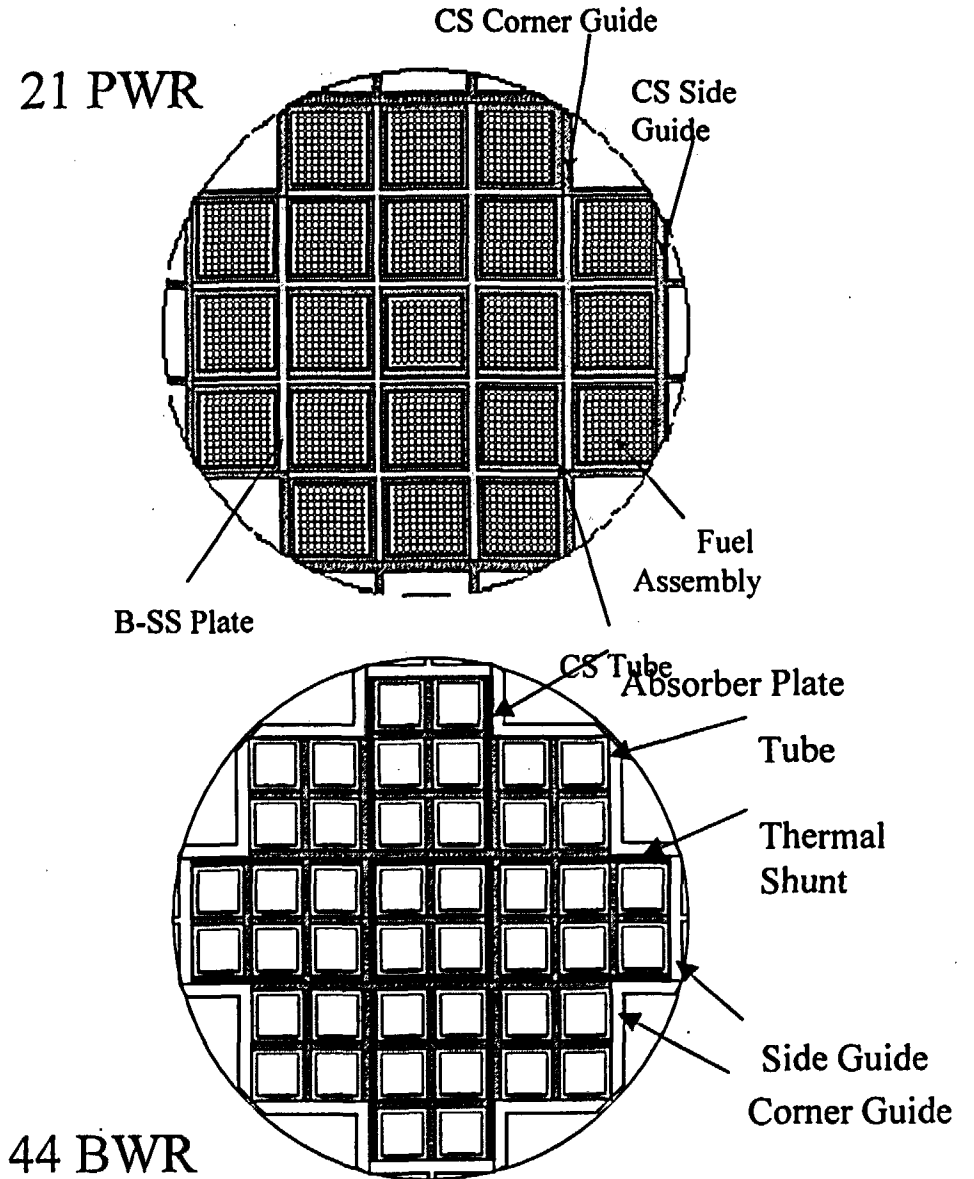
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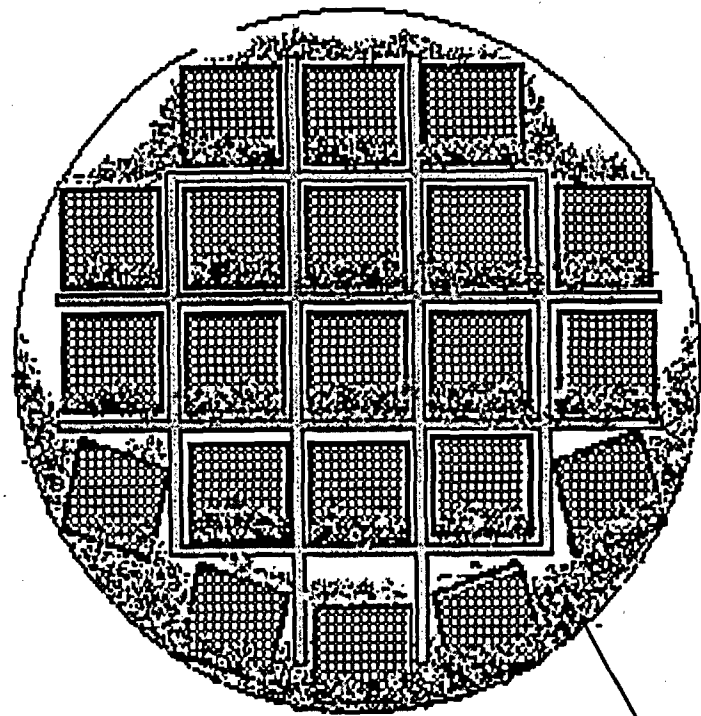
WP Basket Initial Configuration

- Fuel Cells: 5 mm thick, A516 Carbon Steel tube
- Neutron Absorber Plates: 7 mm thick, Borated 316 Stainless Steel, between adjacent assemblies
- Thermal Shunt Plates: 10 mm thick, Aluminum Alloy 6061, on either side of central row and column of basket lattice, provides improved heat conductance
- Side and Corner Guides: 10 mm thick, A516 Carbon Steel, provides structural support for basket



Carbon Steel and Aluminum Component Failure

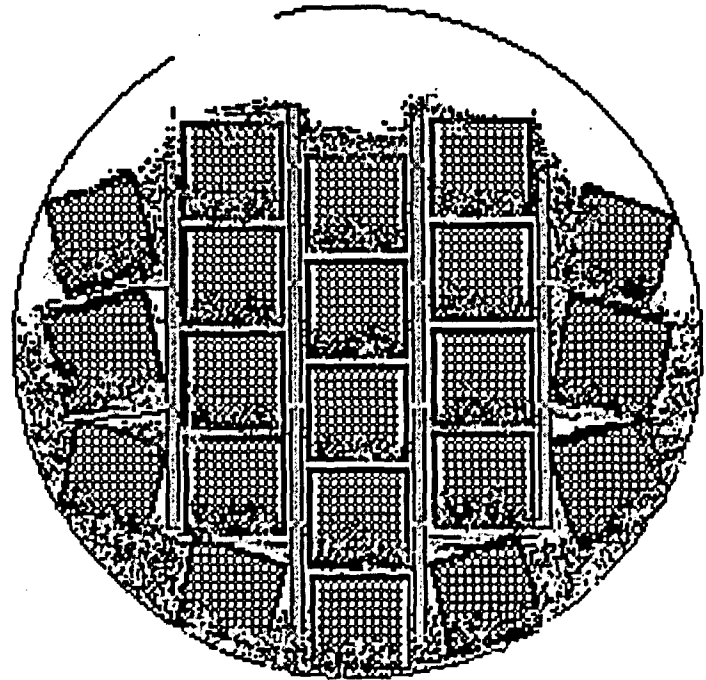
- Occurs 60 to 340 years following WP breach
- Produces ~7700 kg of Fe_2O_3 and ~600 kg of AlOOH
- Structural calculations show that B-SS plates can support fuel load



Iron Oxide from
Basket Degradation

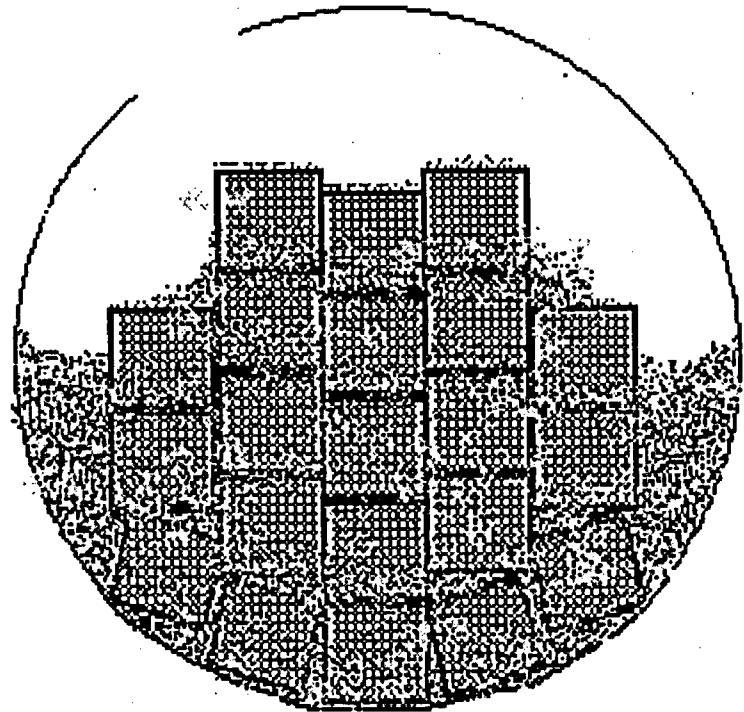
Fully Collapsed Basket

- All assemblies collapse toward bottom with remaining B-SS plate in between
- ~3,100 years following breach required for general corrosion to produce thinning required for collapse (2.5 mm removed)
- Localized corrosion mechanisms would be expected to produce collapse earlier than general corrosion



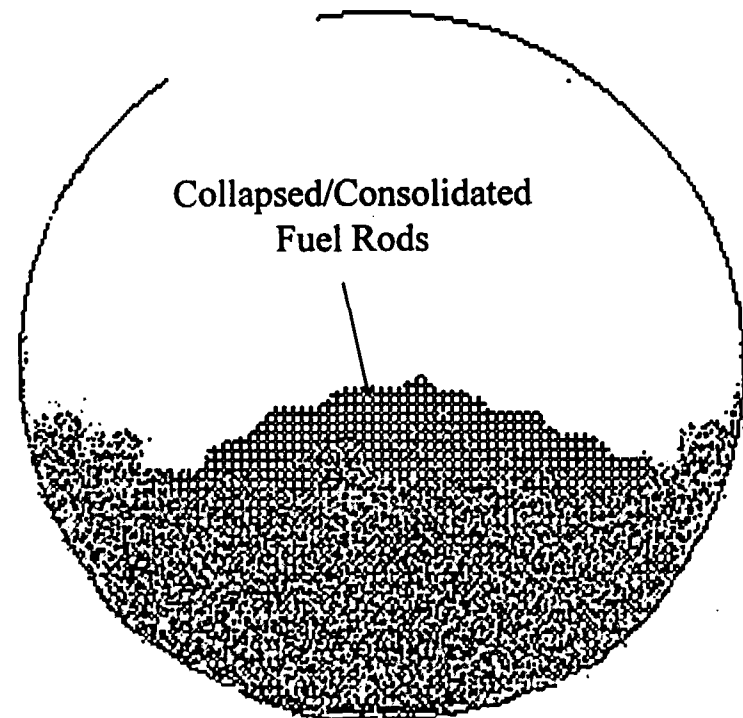
Fully Degraded Basket with Intact Assemblies

- All basket components degraded. Zircaloy clad assemblies collapsed to bottom of WP
- Occurs ~8,800 years after breach (range 1,000 to 40k years)
- Structural calculations show that bottom-most assemblies can support load of those above.
- 9,300 kg of Fe_2O_3 mixed in and around assemblies



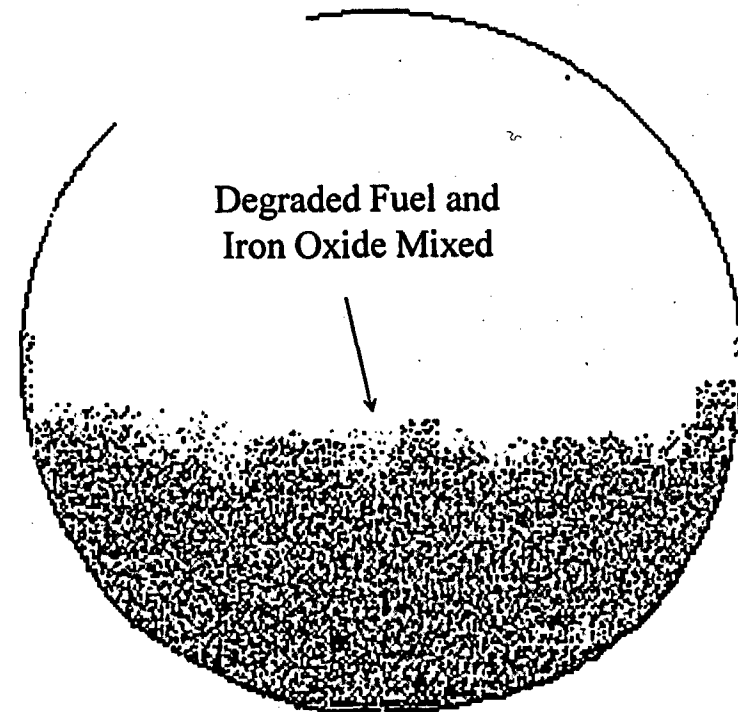
Fully Degraded Basket and Assembly Structure Intact Fuel Rods

- Spacer grids degrade causing rods to collapse
- Spacers are generally thinner than cladding, and are fabricated from less corrosion resistant Inconel or SS for ~25% of PWR assemblies



Fully Degraded Basket and Fuel

- Degraded fuel pellets, cladding remnants, and basket corrosion products mixed at bottom of WP
- At theoretical density, corrosion products will occupy ~63% of the internal void space
- Final internal WP configuration



BWR WP Fully Degraded Basket with Intact Fuel

- BWR WP may have different intermediate degraded configuration due to presence of Zircaloy channel around assemblies
- Prevents oxide from entering fuel rod region
- May maintain some separation between assemblies

